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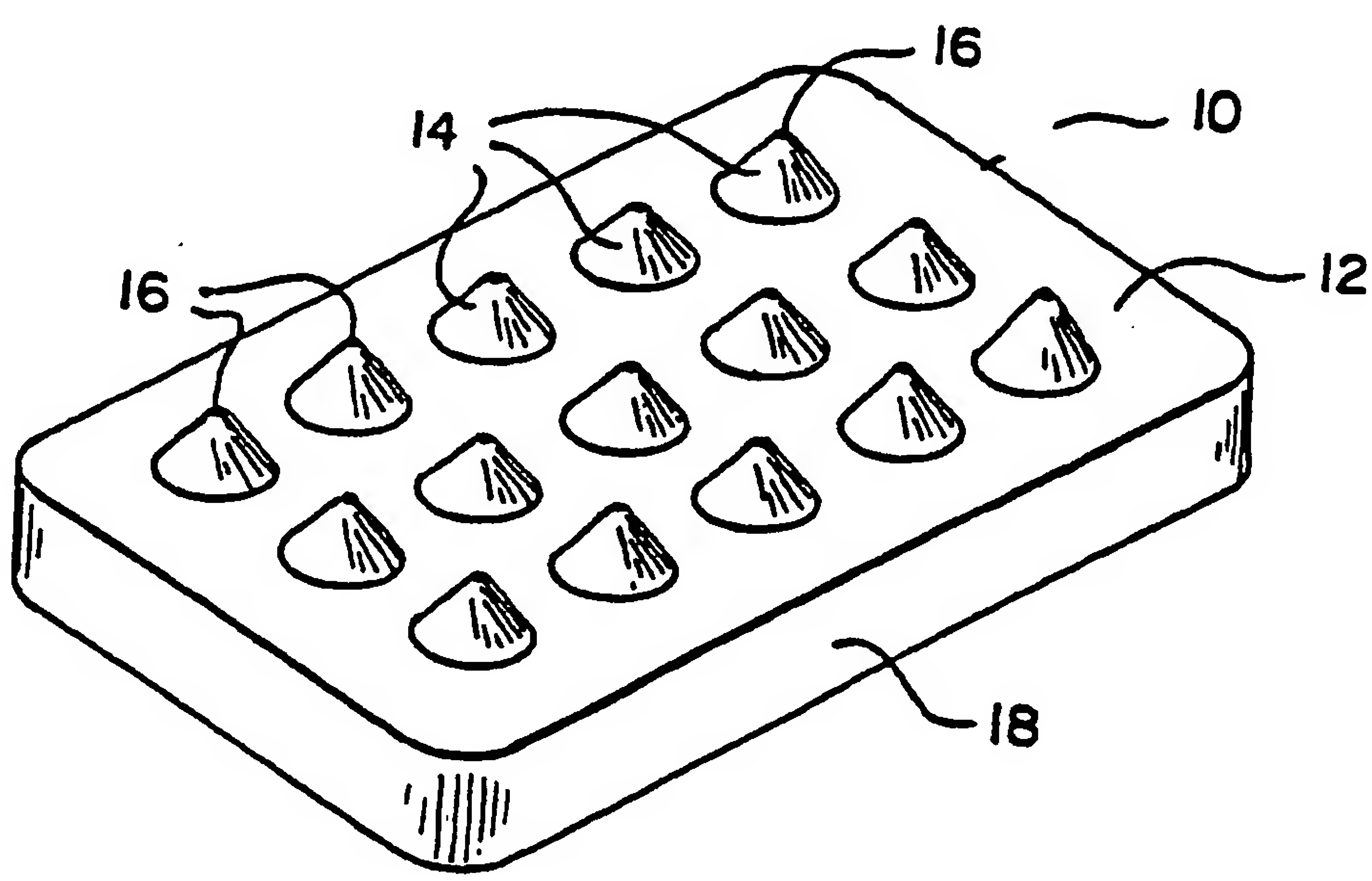
(54) Title: SCRUBBING SPONGE AND METHOD FOR MAKING SAME



(57) Abstract

A scrubbing sponge (10) is disclosed which has a body and projections (14) extending from the body which are of greater density and preferably frusto-conical in shape. The mold (20, 30) for the sponge is preferably a two piece mold, one (20) of which contains vented cavities (24) which define the projections.

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TITLE

SCRUBBING SPONGE AND METHOD FOR MAKING SAME

Field of Invention

This invention relates to artificial sponges for cleaning purposes.

Background of the Invention

Sponges are used for a variety of cleaning purposes including washing the human body and scrubbing floors. The ordinary sponge is generally soft and pliable when wet. Although various types of sculptured sponges have been used in the past, for the most part all of them had a uniform surface texture. Sponges have also been combined with plastic brushes by clipping them or molding them to the plastic brush. These products are typically more expensive than a sponge alone. There is a need for a sponge which has a scrubbing surface as well as a smooth surface that can be molded of a single material. I provide a sponge which may be molded from polyurethane using a two piece mold. My sponge preferably has one flat face and an opposite face having frusto-conical projections, the tips of which are significantly harder than the surface of the sponge. These hard tips provided improved scrubbing action. The tips are formed during the molding process. The sponge is particularly useful for medical applications.

Brief Description of the Drawings

Figure 1 is an perspective view of the sponge of the present invention;

Figure 2 is a perspective view partially in section of the mold used to make the sponge of Figure 1;

Figure 3 is a perspective view similar to Figure 2 after

the mold has been filled with a foam material and the foaming reaction has been completed;

Figure 4 is a perspective view of the bottom half of a mold of Figure 2;

Figure 5 is a perspective view of the top half of the mold of Figure 2; and

Figure 6 is a graph of the data in Table I.

Description of the Preferred Embodiments

Referring to Figure 1, I provide a sponge which is preferably generally rectangular. Sponge 10 preferably has one flat underside surface which is not visible in the drawings and a top surface 12 having a plurality of frusto-conical projections 14. Each projection has a tip 16 which is substantially harder than the surface of sponge 10. These hard tips provide improved scrubbing action.

Sponge 10 is formed in a two piece mold shown in Figures 2 thru 5. The top 20 of the mold has a plurality of preferably frusto-conical cavities 24 each of which is connected to a vent tube 26 that extends through the top 20 of the mold. Cavities 24 could also be truncated pyramids or any similar shape in which diameters through the projection become progressively smaller as one moves toward the vent. The bottom half the mold 30 preferably has a generally rectangular cavity 32. This cavity 32 may have an insert or further cavity 34 to apply a brand name or other marking on the surface of the sponge. I prefer to provide for a depth of cavity 32 which will be equal to the height of the sponge and thereby form sides 18 of the sponge.

I prefer to make a sponge having a plurality of projections 14 which are approximately 0.25 inches in diameter at their base and have a height of 0.2 inches. Preferably, the height of sides 18 of the sponge is 0.375 inches. The base diameter of the projections 14 is preferably 0.35

inches. I prefer to make the vent holes 26 approximately 0.07 inches in diameter. I have found that making a frusto-conical cavity 24 having a sidewall which forms an angle of 83 degrees from horizontal is most satisfactory. I prefer to provide a 1/2 inch spacing between adjacent frusto-conical projections 14. I further prefer to provide a sponge which is two inches wide and three inches long.

In figure 3, I have shown the mold partially cut away after it has been filled with the raw materials and allowed to foam. When the raw materials are added to the mold they are placed in the bottom half 30 of the mold. Sufficient raw material is placed in mold cavity 32 so that during forming the foam will pass through the vents 26. The amount of material placed in the mold as well as the degree of venting will affect the density of the foam. I prefer to make my sponge of a density from 7 pounds per cubic inch to 18 pounds per cubic inch. I have found that the HYPOL prepolymer of W. R. Grace Company can be used to make a suitable foam material.

During the foaming step the material which has been placed in cavity 32 expands as carbon dioxide is generated. Air in the mold escapes through vents 26. As the foam expands, it fills cavities 24 and continues through vents 26 to form flashing 36 on top of the mold. After foaming has completed that flashing 36 is removed and the top half 20 of the mold is separated from the bottom half 30. During foaming the material becomes much denser as it passes through the frusto-conical section and vents 26. When the mold is separated some flashing will remain attached to frusto-conical portions 14. These rods of flashing 38 are quite stiff and relatively dense. They can easily be broken from the frusto-conical portion 14. When that is done a tip 16 of very dense material will remain. I have found that dense hard tip provides an improved scrubbing feature to my sponge. The density of the tip 16 and flashing 36 will be

affected by the diameter and length of the vents 26. As the foam passes through the frusto-conical section and vent 26 during the foaming cycle it will become dense because of the progressively restrictive flow leading to the small opening of the vent. Additionally, air escapes from the gas cells within the foam as they break passing through vent 26.

The sizing of the vent holes will depend upon the nature of the material used for the sponge and the length of the vents 26. The holes must be small enough to cause sufficient densification, but not so small as to become clogged or to prevent sufficient venting during molding. I have found that fifteen vent holes approximately 0.07 inches in diameter work well for a sponge 0.375 inches thick, three inches wide and four inches long.

Although the sizing of the vent holes will determine the difference in density of the projections and the density of the sponge body, those skilled in the art will recognize other factors which will determine the actual density of the body and projections. Fillers could be added to increase density. Density is also related to cell size and strength which can be changed by many known techniques.

I have found that any projection which is harder or stiffer than the sponge body provides improved scrubbing action. However, it appears that the stiffest projections work best. Since the stiffness of the projections is proportional to their density in a homogenous formulation one can relate projection density to density of the sponge body. Also since the density of the scrubbing projections is apparently controlled by their venting, a series of scrub sponges having different vent sizes were used to determine the vent size at which the density of the cones is maximized.

Sponges were made using a standard sponge mold having the dimensions of 3" x 2" x .6". A series of different mold tops having frusto-conical cavities with vent sizes ranging in

diameter from 19 mils to 133 mils with a vent length of 50 mils were used to make the sponges. The sponges were made from a 1:1 mixture of Hypol 2002 and water with 2% Brij 72. Enough material was poured into the mold so that approximately 50% would flow out of the vents. The sponges were demolded after approximately 8 minutes and allowed to cure several days wet. The sponges were frozen using liquid nitrogen and the cones were scythed from the body of the sponge. Both sponge bodies and cones were then dried for one half hour at 100% C followed by conditioning for three days at 50% relative humidity. The sponge bodies and cones were then weighed and measured. Densities for each were calculated and the density ratio was reported as the ratio of the density of the cone to that of the sponge body and the vent area is reported for a single vent. Table I reports the data shown are for single sponge body samples and an average of 5 cones scythed from that sponge.

Densities were calculated as follows:

Sponge body Density (lbs/ft^3) = w / ((1 x w x h) - cf)) / .2625 where

w = weight of sponge body in grams

1 = length of sponge body in inches

w = width of sponge in inches

h = height of sponge in inches

cf = correction factor used to account for a lower volume for the sponge body due to corner round and logo

Scrub cone Density (lbs/ft^3) is

$$\frac{W}{\pi \times \frac{H}{3} \times \left(\left(\frac{D1}{2}\right)^2 + \left(\frac{D1}{2} \times \frac{D2}{2}\right) + \left(\frac{D2}{2}\right)^2\right)} \div .2625$$

where w = weight of the cone in grams

H = the height of the cone in inches

D1 = the base diameter of the cone in inches

D2 = the tip diameter of the cone in inches

TABLE I

Vent Diameter (mils)	Vent Area ($mils^2$)	Density (lbs/ft^3) Body	Density (lbs/ft^3) Cone	Density Ratio
19	283.5	17.39	19.17	1.102
29	660.5	13.68	16.42	1.200
39	1194.6	13.16	15.88	1.207
50	1963.5	13.02	17.32	1.330
59	2734.0	12.68	19.16	1.511
70	3848.4	11.91	18.46	1.550
80	5026.5	13.44	21.34	1.588
94	6939.8	12.37	23.82	1.925
125	12271.8	10.76	20.23	1.880
133	13892.9	10.39	18.31	1.762

The date of Table I is plotted in Figure 6. Then, I fit a curve to the data point by regression analysis. The regression relation of density ratio to vent area using a 2nd degree polynomial is:

$$\text{Density Ratio} = -8.572 \times 10^{-9} x^2 + 1.719 \times 10^{-4} x + 1.0478$$

where X = area of vent in square mils. r^2 for the fit of the regression is .961775

Setting the first derivative equal to zero and solving for X determines the maximum density ratio. For the data of Table I, the curve shows maximum density ratio occurs at 10027

sq. mils or at 106 mils vent diameter. At that point there is a maximum density ratio of 1.909. However, the density ratio for the 94 mil vent indicate that slightly higher ratios or at least 2 to 1 are possible. Moreover, one may be able to add fillers or other additives to alter processing or achieve even greater ratios.

During or after forming my sponge may be infused with soap, fungicides, bacteriastats or other materials. The choice of materials will depend upon the intended use of the sponge.

While I have described and shown certain present preferred embodiments by my sponge and mold for making same, it should be understood that the invention is not limited thereto, but may be variously embodied within the scope of the following claims.

I Claim:

1. A sponge compromised of a foam body having a density, and plurality of projections having a projection density attached to the body wherein the projection density is greater than the body density.

2. The sponge of claim 1 wherein the projections are frusto-conical.

3. The sponge of claim 1 wherein the projections are truncated pyramids or truncated polygons.

4. The sponge of claim 1 wherein the projections have a size and shape so that for any parallel, first and second transverse cross-sections taken through the projections, wherein the first transverse cross-section is closer to the sponge body than the second transverse cross-section, the first cross section will have greater area than the second cross section.

5. The sponge or claim 1 wherein a ratio of projection density to body density is at least 1.5 to 1.

6. The sponge of claim 1 wherein a ratio of projection density to body density is greater than 2.0 to 1.

7. The sponge of claim 1 also comprising at least one filler in at least one of the body and the projections.

8. A mold for forming a sponge having a body and a plurality of projections extending therefrom compromising a top portion and a bottom portion said portions having a size and shape so that when fitted together they define a body

cavity to form the body of the sponge, said top portion also having:

a) plurality of cavities each of which has a base and a tip said base being adjacent to the body cavity and having a diameter greater than a tip diameter through the tip; and
b) a plurality of vents each vent extending from the tip of the cavity through the top of the mold and having a diameter not greater than the tip diameter.

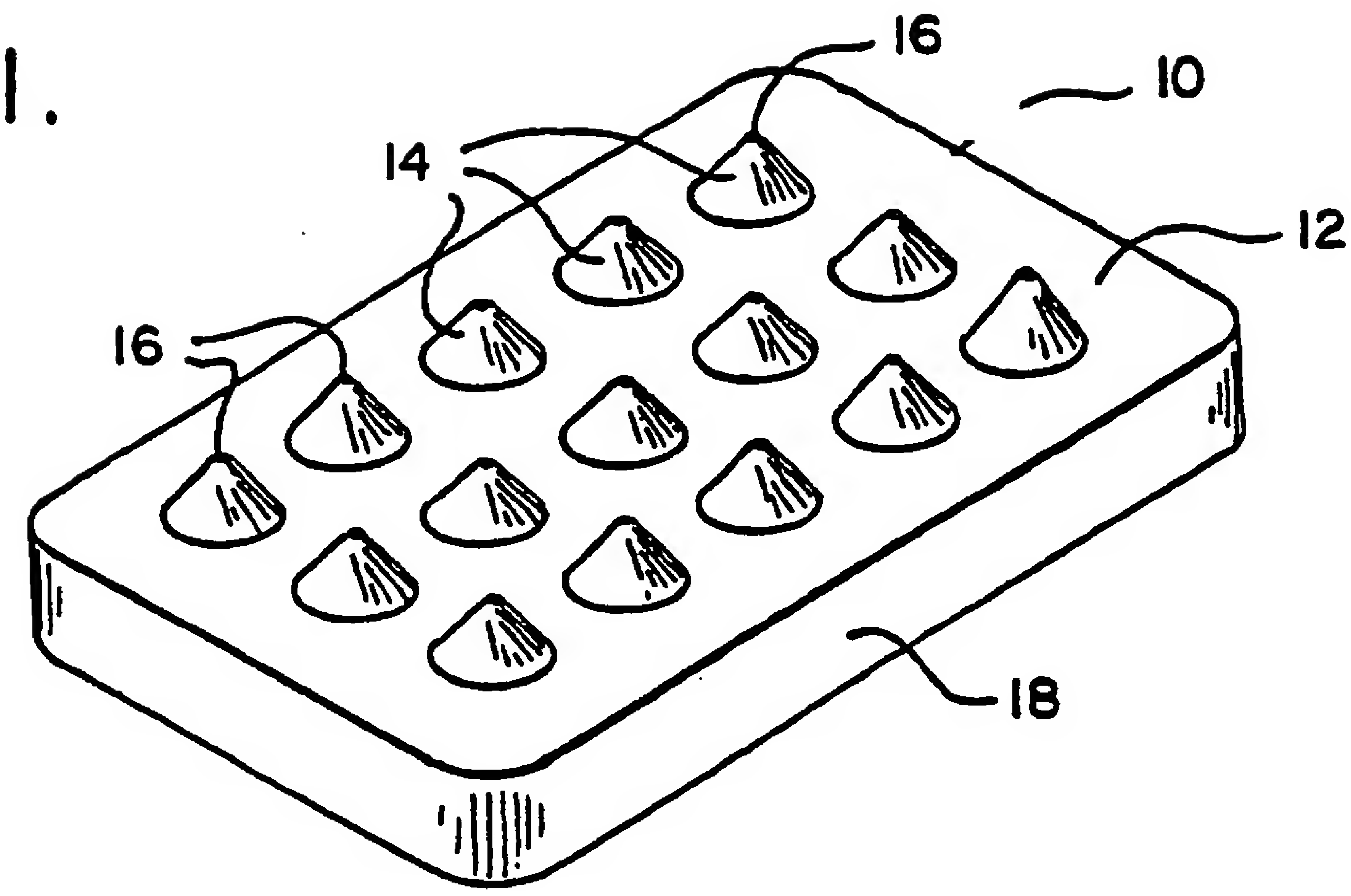
9. The mold of claim 8 wherein the cavities are frusto-conical.

10. The mold of claim 8 wherein a body cavity is provided in the bottom portion of the mold.

11. The mold of claim 8 wherein each vent is at least 19 mils in diameter.

12. The mold of claim 8 wherein each vent has a diameter not greater than 135 mils.

Fig.1.



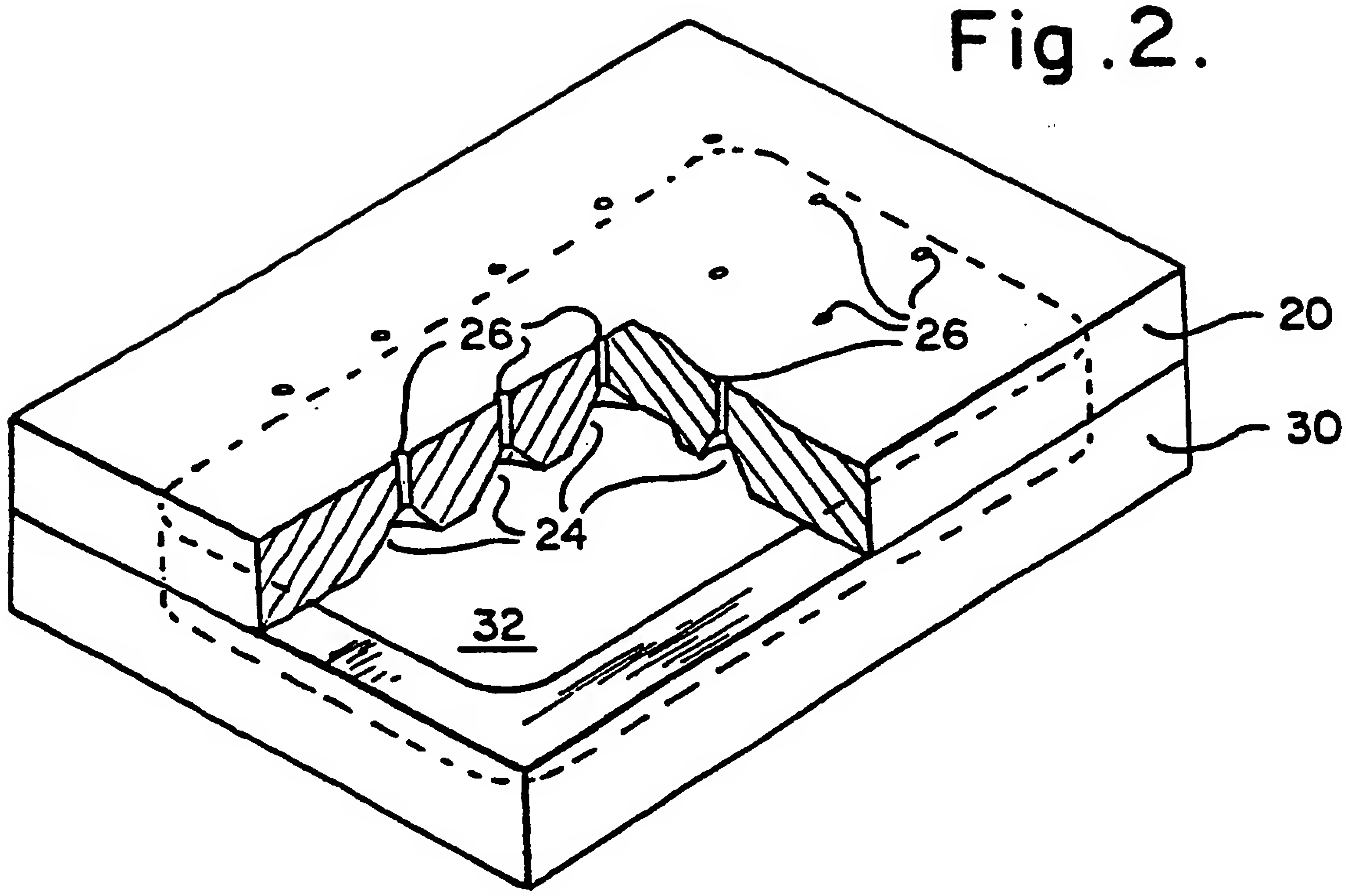


Fig.2.

Fig. 3.

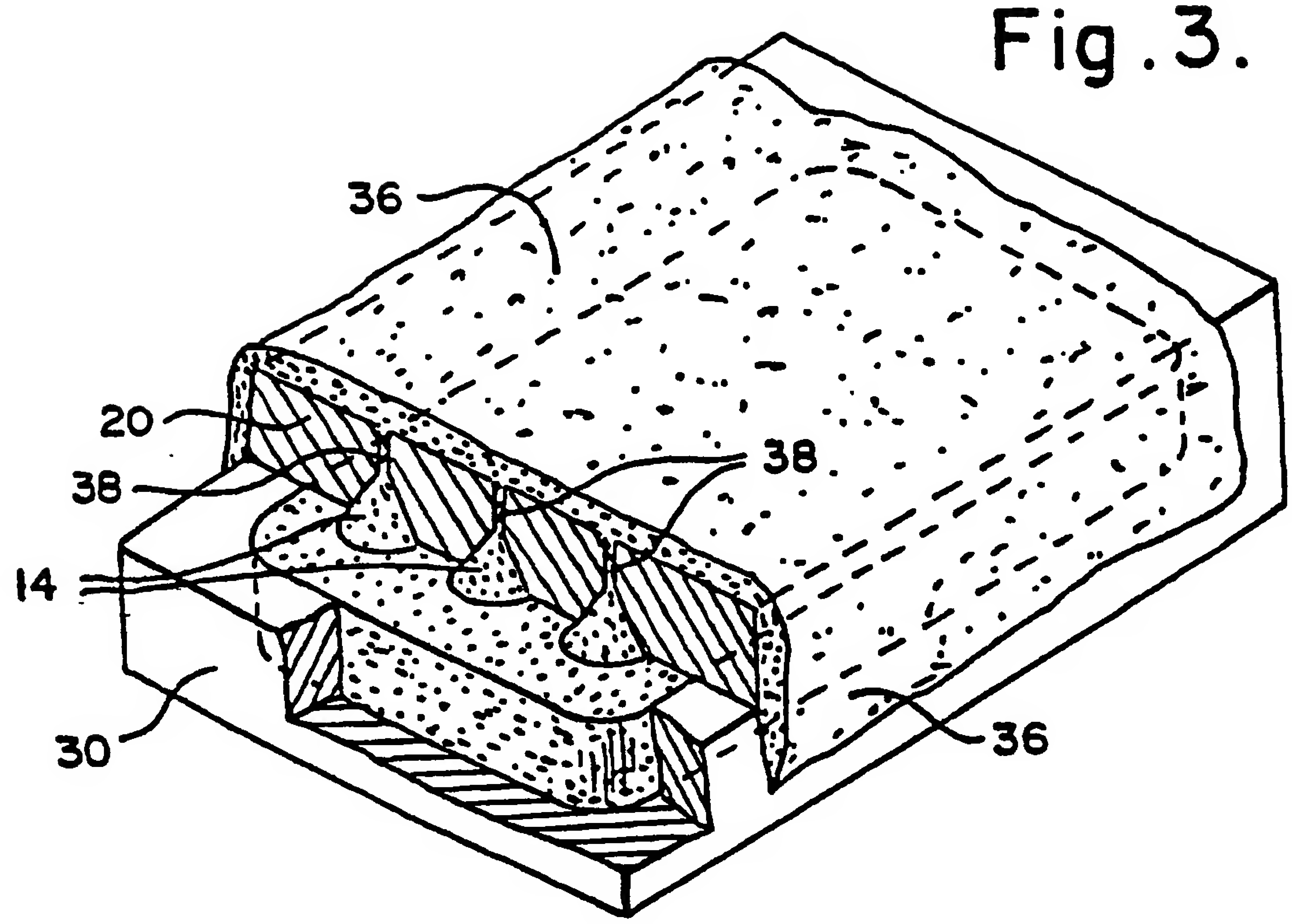


Fig.4.

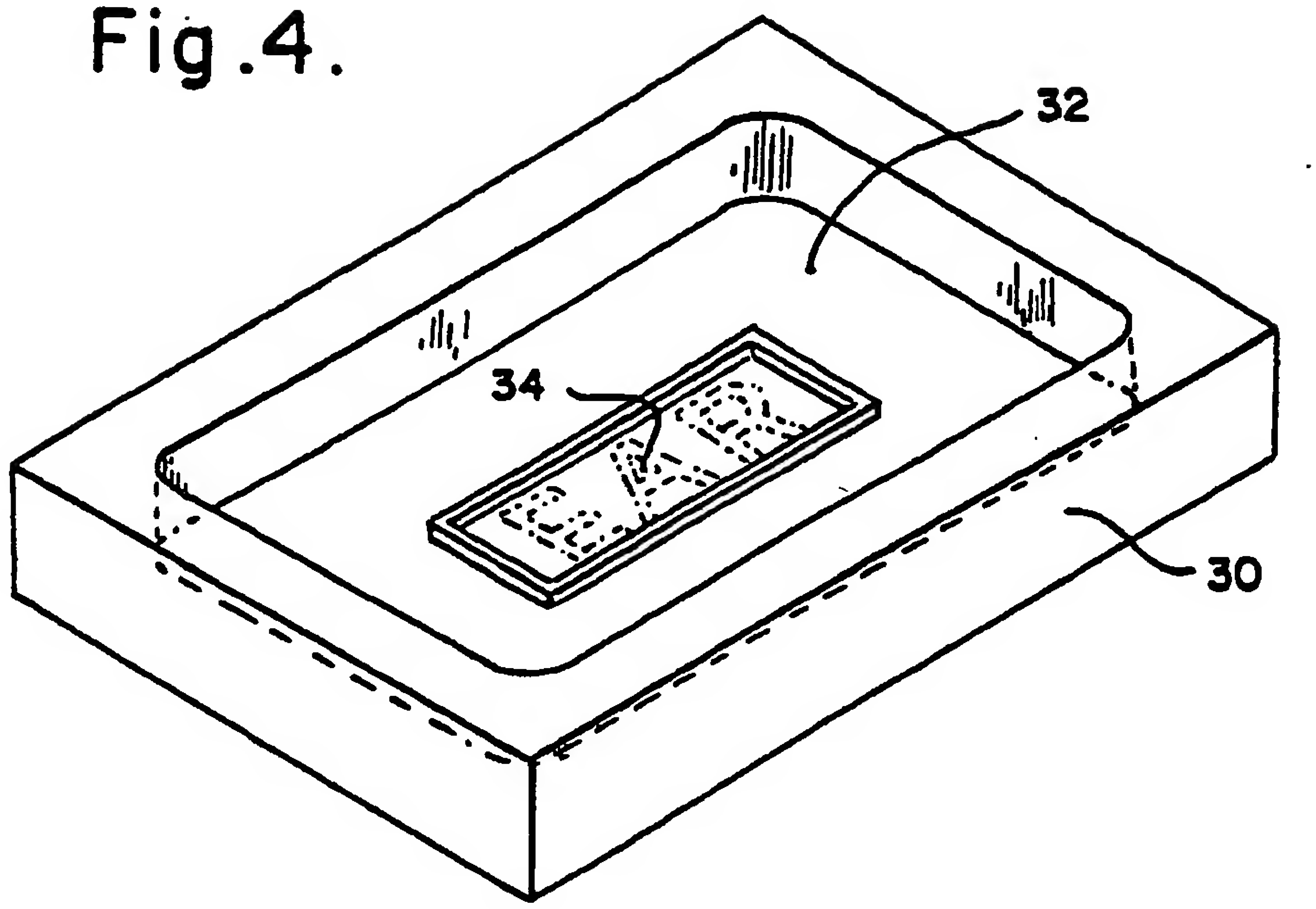
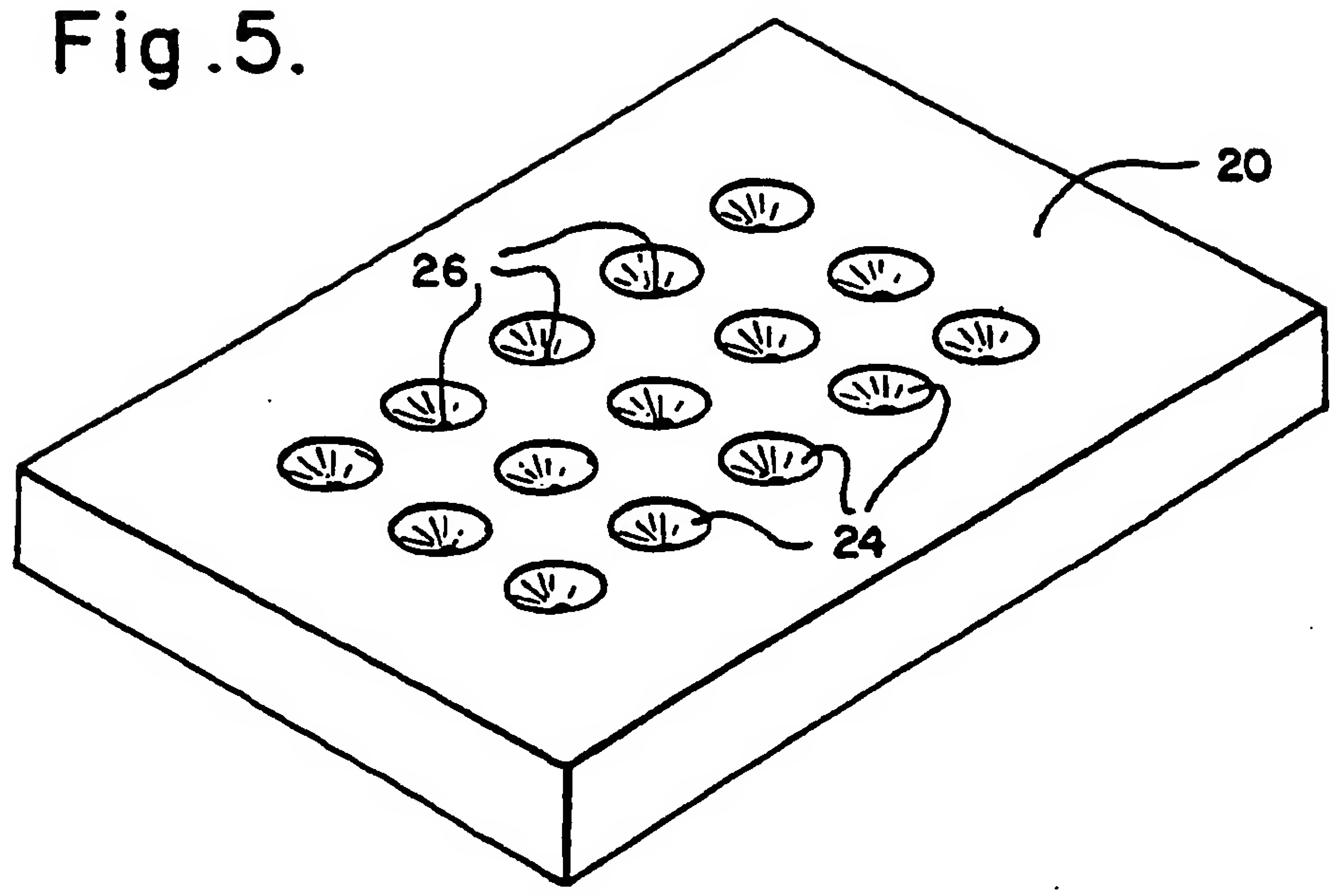


Fig.5.



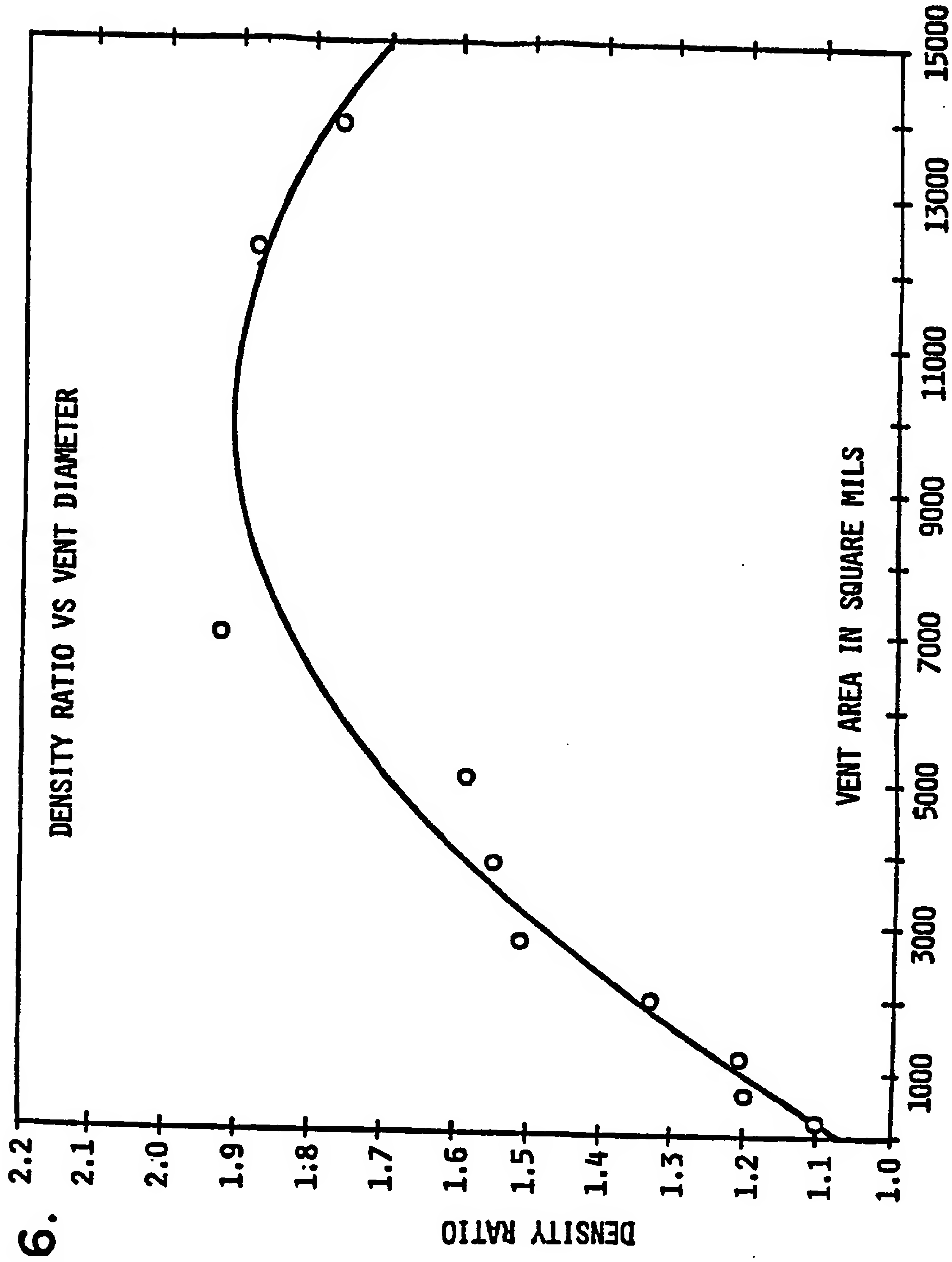

DENSITY RATIO VS VENT DIAMETER
DENSITY RATIO
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
VENT AREA IN SQUARE MILS
1000
3000
5000
7000
9000
11000
13000
15000

Fig.6.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/04284

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4); A47L 13/17 B29C 1/00
U.S.CL. 15/244.1

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	15/187,188,104.061,104.93,210.5,244.1,244.2,244.3, 244.4 249/83,141,160 425/812

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X Y	U.S.,A, 1,987,390 DAVIS 08 January, 1935 (entire document)	1-6 7
X	U.S.,A, 1,877,527 MORAN 13 September, 1932 (entire document)	1-6
Y	U.S.,A, 4,613,446 MAGYAR 23 September, 1986	7
A	U.S.,A, 3,811,647 PINK 21 May, 1974	8-12
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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